1   **CLAIMS**

2   What is claimed is:

3   1.   A method for imparting a watermark onto a digitized image,
4   said method comprising:

5   providing a digitized image having at least one image plane,
6   said image plane being represented by an image array having
7   a plurality of pixels, said pixel having at least one color
8   component, said watermark being formed using a distinct
9   watermarking plane represented by an array having a
10   plurality of distinct watermarking elements, each of said
11   distinct watermarking elements having an array position and
12   having one-to-one positional correspondence with said image
13   pixels, and

14   multiplying said brightness data associated with said at
15   least one color component by a predetermined brightness
16   multiplying factor, wherein said brightness multiplying
17   factor is a corresponding distinct watermarking element, and
18   said watermark has a invisibility classification.

19   2.   A method as recited in claim 1, wherein said brightness
20   multiplying factor has a relationship with a number taken from a
21   random number sequence.

22   3.   A method as recited in claim 2, wherein said relationship is
23   a linear remapping to provide a desired modulation strength.

1   4.   A method as recited in claim 3, wherein said modulation
2   strength lies in the domain greater than or equal to zero and
3   less than or equal to 0.5.

4   5.   A method for imparting a watermark onto a digitized image
5   comprising the steps of:

6   providing said digitized image comprised of a plurality of
7   pixels, wherein each of said pixels includes brightness data
8   that represents a brightness of at least one color; and

9   altering said brightness data associated with a plurality of
10   said pixels maintaining the hue and saturation of said
11   pixel.

12   6.   A method as recited in claim 5, wherein said image has I
13   rows and J columns, and has a pixel in row i and column j having
14   at least one brightness, Y(i,j), and the step of altering
15   includes:

16   adding to or subtracting from the brightness Y(i,j) a different
17   small random value $\varepsilon(i,j)$, wherein $1 \leq i \leq I$ and $1 \leq j \leq J$ are
18   the row and column indices of a pixel location in the image.

19   7.   A method as recited in claim 6, wherein the step of adding
20   to or subtracting from includes making $\varepsilon(i,j)$ proportional to an
21   original brightness of the pixel.

22   8.   A method as recited in claim 6, wherein color components of
23   the unaltered pixel are X(i,j), Y(i,j), and Z(i,j), and color

1   components of the brightness altered pixel are X'(i,j), Y'(i,j),

2   and Z'(i,j), and the step of adding to or subtracting from

3   includes setting $\varepsilon(i,j) = \delta(i,j)Y(i,j)$, where $\delta(i,j)$ is a value

4   selected from an array of random values within a range of $0 \leq$

5    $\delta(i,j) \leq 1$, such that the modified brightness Y'(i,j) =

6    $Y(i,j)+\varepsilon(i,j) = Y(i,j)+\delta(i,j)Y(i,j)$, and X'(i,j)/X(i,j) =

7    $Z'(i,j)/Z(i,j) = Y'(i,j)/Y(i,j) = \varepsilon(i,j) = 1-\delta(i,j)$.

8   9.   A method as recited in claim 8, wherein the step of setting

9   includes preserving ratios of color components in each pixel.

10   10.   A method as recited in claim 9, wherein the step of

11   preserving includes setting X'(i,j)/X(i,j) = Z'(i,j)/Z(i,j) =

12   $Y'(i,j)/Y(i,j) = 1-\delta(i,j)$, wherein the color components of the

13   unaltered pixel are X(i,j), Y(i,j), and Z(i,j), and the color

14   components of the brightness altered pixel are X'(i,j), Y'(i,j),

15   and Z'(i,j).

16   11.   A method for imparting a watermark onto a digitized image

17   comprising the steps of:

18   providing said digitized image comprised of a plurality of

19   pixels, wherein each of said pixels includes brightness data

20   that represents a brightness of at least one color, with

21   said image having I rows and J columns, and a pixel in row i

22   and column j having a brightness Y(i,j); and

23   for a plurality i and at least one j adding to or

24   subtracting from the brightness Y(i,j) a random value

1     $\varepsilon(i,j)$, wherein $1 \leq i \leq I$ and $1 \leq j \leq J$ are the row and

2   column indices of a pixel location in the image.

3   12.   A method as recited in claim 11, wherein $\varepsilon(i,j)$ is in the

4   domain 0 to 1 multiplied by $Y(i,j)$.

5   13. A method for generating a watermarked image, the method

6   comprising:

    imparting a watermark onto a digitized image having a

    plurality of original pixels, each of said pixels having at

    least one original pixel brightness value;

10   providing said digitized watermarking plane comprising

    a plurality of watermarking elements, each element

    having a watermark brightness multiplying factor and

    having one-to-one positional correspondence with said

    original pixels; and

15   producing a watermarked image by multiplying said

16   original brightness of each of said original pixels by

17   said brightness multiplying factor of a corresponding

18   one of said watermark elements.

19   14. A method comprising:

20   forming a watermarking plane including a plurality of elements

21   each having a brightness adding or subtracting factor, including

22   the steps of:

1   generating a secure random sequence of integers having
2   a first plurality of bits;

3   linearly remapping said random sequence to form a
4   remapped sequence of brightness multiplying factors to
5   provide a desired modulation strength;

6   computing a discrete Fourier transform of said remapped
7   sequence to form a Fourier sequence having frequency
8   coordinates;

9   expanding said frequency coordinates to form an
10   expanded sequence;

11   computing an inverse discrete Fourier transform of said
12   expanded sequence to obtain a watermarking sequence of
13   values; and

14   deriving said brightness adding or subtracting values
15   of said elements of said watermarking plane based upon
16   said watermarking sequence of values.

17   15. A method for detecting a watermark in a marked image, said
18   method comprising:

19   providing said marked image marked by a watermarking plane,
20   said marked image having at least one color plane including
21   a plurality of image pixels, said watermarking plane having
22   a plurality of watermarking elements, wherein each of said
23   image pixels has at least one brightness value and each of

1   said watermarking elements has a brightness adding and/or
2   subtracting factor, including the steps of:

3   (a) reconstructing said watermarking plane;

4   (b) aligning said watermarking plane with said marked
5   image such that each watermarking element has a
6   corresponding image pixel;

7   (c) providing a selector array and a visualizer image
8   of equal size, wherein said selector array has a
9   plurality of selector elements each having at least one
10   counter, and wherein said visualizer image has a
11   plurality of visualizer pixels each having at least one
12   brightness value, and wherein said visualizer pixels
13   represent a recognizable pattern when displayed;

14   (d) resetting said at least one counter to zero;

15   (e) placing said selector in an initial position by
16   aligning said selector elements with a plurality of
17   corresponding image pixels and a plurality of
18   corresponding watermarking elements;

19   (f) choosing a selector element and identifying a
20   corresponding watermarking element;

21   (g) identifying a first plurality of watermarking
22   elements that neighbor said corresponding watermarking
23   element;

1 (h) generating a first average that represents an

2 average of brightness multiplying factors of said first

3 plurality of watermarking elements;

4 (i) choosing a color plane of said marked image and

5 finding a corresponding image pixel;

6 (j) identifying a first plurality of neighboring pixels

7 that neighbor said corresponding image pixel;

8 (k) generating a second average that represents an

9 average of brightness values of said first plurality of

10 neighboring pixels;

12 (l) updating said at least one counter based upon first

13 and second comparison operations, wherein said first

14 comparison operation compares said first average with

15 said brightness multiplying factor of said

16 corresponding watermarking element and said second

17 comparison operation compares said second average with

18 said brightness value of said corresponding pixel;

19 (m) repeating steps (i) through (l) for all color

20 planes;

21 (n) repeating steps (f) through (m) for all selector

22 elements;

23 (o) choosing a new selector position that does not

24 overlap any previous selector position;

1   (p) repeating steps (f) through (o) for all
2   non-overlapping selector positions; and

3   (q) generating a visual representation indicating
4   detection of said watermark in said marked image
5   utilizing said at least one counter of said selector
6   array and said visualizer pixels.

7   16.   A method for detecting a watermarking plane comprising the
8   steps of:

9   providing an image having a plurality of image pixels,
10   u(i,j), with said image having I rows and J columns, and a pixel
11   in row i and column j having at least one component, marked by a
12   watermarking plane; said watermarking plane having a plurality of
13   watermarking elements, w(i,j), with said watermarking plane
14   having I rows and J columns, and an element in row i and column j
15   having a brightness multiplying factor;
16   aligning said watermarking plane with said image;

17   identifying a subset of said image elements;

18   for each pixel, u(i,j), of said subset of image pixels,

19   generating a first value representing a relationship
20   between an attribute of said pixel u(i,j) and an
21   attribute of image pixels that neighbor said pixel
22   u(i,j);

23   identifying a watermarking element, w(i,j), that
24   corresponds to said pixel u(i,j) and watermarking

1   elements that correspond to said image pixels that

2   neighbor said image pixel u(i,j);

3   generating a second value representing a relationship

4   between an attribute of said watermarking element

5   w(i,j) and an attribute of the identified watermarking

6   elements; and

7   generating a coincidence value representing a

8   likelihood that said image is marked by said

9   watermarking plane based upon said first and second

10   values.

11 17. A method as recited in claim 1, wherein said distinct

12 watermarking element, has a value being in the domain greater

13 than or equal to zero and less than or equal to one.

14 18. A method for imparting a watermark onto a digitized image

15 comprising the steps of:

16   providing said digitized image comprised of a plurality

17   of image pixels with said digitized image having I rows

18   and J columns, and a pixel in row i and column j having

19   at least one component, Y(i,j); and

20   adding to or subtracting from said brightness data

21   associated with at least one of said pixels a

22   predetermined brightness adding factor in the range of

23   0 to Y(i,j), or brightness subtracting factor in the

24   range of 0 to Y(i,j).

1   wherein said brightness adding or subtracting factor has a

2   relationship with a number taken from a random number sequence,

3   said relationship is a linear remapping to provide a desired

4   modulation strength, and said modulation strength is less than or

5   equal to 50 percent.

6   19. A method for imparting a watermark onto a digitized image

7   comprising the steps of:

8   providing said digitized image comprised of a plurality

9   of image pixels with said image having I rows and J

10   columns, and a pixel in row i and column j having at

11   least one component, $Y(i,j)$; and

12   adding to or subtracting from said brightness data

13   associated with at least one of said pixels by a

14   predetermined brightness adding or subtracting factor

15   in the range of 0 to $Y(i,j)$,

16   wherein said brightness adding or subtracting factor has a

17   relationship with a number taken from a random number sequence,

18   said relationship is a linear remapping to provide a desired

19   modulation strength, said sequence is formed from a plurality of

20   robust watermarking parameters, and said parameters comprise a

21   cryptographic key, two coefficients and an initial value of said

22   random number generator.

23   20. A method for detecting a watermark, said method comprising:

1 providing a marked image having a plurality of image pixels said
2 marked image being marked by a watermarking plane, having a
3 plurality of watermark elements;

4 aligning said watermarking plane with said marked image, and

5 generating a coincidence value by averaging a detection
6 coincidence for each selector element of a group of selector
7 elements taken from said image pixels.

8
9 21. A method as recited in claim 20, wherein each of said group
10 of selector elements has a selector size, said method further
11 comprising:

12 providing a visualizer pattern having a plurality of visualizer
13 pixels and a visualizer size equal to said selector size, each of
14 said visualizer pixels being associated with one of said selector
15 elements and having a visualizer color; and

16 displaying a watermark detection pattern having a size at least
17 equal to said visualizer size and a plurality of
18 visualizer-coincidence pixels, wherein each of said
19 visualizer-coincidence pixels is associated with a corresponding
20 selector element and a corresponding visualizer pixel, and each
21 of said visualizer-coincidence pixels being displayed having said
22 visualizer color when said coincidence value of said
23 corresponding selected element has an indication of a detection
24 success and having another color otherwise.

1   22. A method as recited in claim 20 wherein said watermark is
2   based on a factor multiplying a brightness value of each of said
3   image pixels.

4   23. A method as recited in claim 20, further comprising:

5   reconstructing said watermarking plane used in generating said
6   watermark.

7   24. A method as recited in claim 23, wherein said watermarking
8   plane has a plurality of watermarking elements, said method
9
10   further comprising:

11   rotating, resizing and said image to bring it to a size and
12   position of an original image, and

13   aligning said watermarking plane with said marked image such that
14   each of said watermarking elements has a corresponding image
15   pixel.

16   25. A method as recited in claim 20, wherein each said group
17   contains 128 elements.

18   26. A method as recited in claim 20, wherein each pixel of said
19   image pixels has a monochrome brightness value.

20   27. A method as recited in claim 20, wherein said watermarking
21   plane is generated using a plurality of robust watermarking
22   parameters.

1   28.   A method as recited in claim 20, wherein said coincidence
2   variable is determined using a statistically related attribute
3   relating each said selector element to a plurality of neighboring
4   elements.

5   29.   A method as recited in claim 28, wherein said attribute is a
6   brightness value.

7

8   30.   A method for detecting a watermark imparted on an image,
9   said method comprising:

10   providing said image having at least one image plane, said image
11   plane being represented by an image array having a plurality of
12   image elements, said watermark being formed using a watermarking
13   plane represented by a watermarking array having a plurality of
14   watermarking elements, each of said watermarking elements having
15   a first array position and having one-to-one positional
16   correspondence with said image elements;

17   computing a first statistically related variable for each element
18   of at least one first grouping of a first selector array of
19   elements taken from said image elements, wherein each of said
20   image elements has a second array position;

21   computing a second statistically related variable for each
22   element of at least one second grouping of a second selector
23   array of elements taken from said watermarking elements, wherein
24   each element of said second selector array of elements has
25   one-to-one positional correspondence with said first selector
26   array, and wherein said correspondence forms combinations of
27   corresponding elements;

1   comparing to determine an affirmative and non-affirmative

2   likeness of said first and second statistically related variables

3   for each of said combinations of corresponding elements; and

4   forming at least one comparison array having one-to-one

5   correspondence with said at least one first grouping and having a

6   plurality of comparison elements, wherein each of said comparison

7   elements contains a positive detection indication for each

8   element of said first grouping when said step of comparing

9   results in an affirmative likeness, and a negative detection

10 indication for each element of said first grouping when said step

11 of comparing results in a non-affirmative likeness.

12 31. A method as recited in claim 30, wherein said watermark is

13 formed by adding or subtracting a brightness factor of each of

14 said image elements by an amount contained in a corresponding

15 element of said watermarking elements.

16 32. A method as recited in claim 30, wherein said first grouping

17 corresponds to a selector positioned to encompass said first

18 selector array of elements forming a rectangular cluster of

19 elements.

20 33. A method as recited in claim 30, wherein said first

21 statistical variable is formed by comparing an attribute of said

22 each element of said first selector array of elements to an

23 average attribute of its 128 closest neighbors.

1 34. A method as recited in claim 30, wherein said attribute is a
2 ratio of the color component to the average of neighboring color
3 components in the same color plane.

4 35. A method as recited in claim 30, wherein each of said at
5 least one first grouping is positioned so as not to overlap any
6 other of said at least one first grouping.

7

8 36. A method as recited in claim 30, wherein each said
9 comparison elements has a particular position in said comparison
10 array, said method further comprising:

11 determining an average percentage of said affirmative and
12 non-affirmative likeness of each element of said comparison
13 elements having a same particular position in all arrays of said
14 at least one comparison array, and

15 forming a detection array of elements having one-to-one element
16 correspondence with said comparison elements, wherein each
17 element of said detection array of elements contains said average
18 percentage.

19 37. A method as recited in claim 36, further comprising the
20 steps of:

21 providing a visualizer pattern of pixels represented by an array
22 having visualizer pixels which have one-to-one element
23 correspondence with said detection array, each of said visualizer
24 pixels has a first logical value if a corresponding visualizer
25 pixel is black, and a complementary logical value if said
26 corresponding pixel is white;

1 forming a visualizer coincidence image having a plurality of
2 coincidence pixels, wherein a coincidence pixel has a
3 corresponding visualizer pixel and a corresponding detection
4 array element; and

5 setting said coincidence pixel to black if both said
6 corresponding visualizer pixel is black and said percentage
7 average of said corresponding detection array element has a value
8 greater than a predetermined detection threshold, otherwise
9 setting said coincidence pixel to white.

10 38. A method as recited in claim 30, wherein said image has
11 three color planes.

12 39. A method comprising generating a visual representation of a
13 data array of data elements having a data array size, including
14 the steps of:

15   providing a visualizer pattern of visualizer pixels
16   represented by a visualizer array of visualizer pixels, said
17   visualizer array having a visualizer array size equal to
18   said data array size;

19   forming a visualizer-coincidence image of image pixels
20   represented by an image array having an image array size
21   equal to said visualizer array size;

22   setting each said visualizer-coincidence pixel to the color
23   of said corresponding visualizer pixel if a value of said
24   corresponding data element is above a predetermined

1   threshold and to another color if said value is below said

2   predetermined threshold; and

3   displaying said visualizer-coincidence image to form said

4   visual representation.

5 40. A method as recited in claim 39, wherein said data array

6 represents data resulting from a watermark detection

7 implementation.

8 41. A method as recited in claim 39, wherein said first color is

9 black and said second color is white.

10 42. A method as recited in claim 39, wherein said threshold is

11 set at a fifty percent success rate.

12 43. A method for demonstrating an existence of a watermark in a

13 marked image, said image having a plurality of image pixels, said

14 method comprising:

15 providing a visualizer pattern represented by an array of

16 visualizer elements, each of said visualizer elements

17 corresponding with one pixel of a plurality of visualizer pixels

18 and having a first value if said one pixel has a first color and

19 a second value if said one pixel has a second color, said

20 visualizer array having a visualizer array size;

1   implementing a watermark detection scheme and computing a

2   coincidence value for each of said image pixels within a

3   plurality of pixel selector arrays taken from among said image

4   pixels, each of said pixel selector arrays having a selector

5   array size equal to said visualizer array size;

6

7   forming a detection array from a plurality of coincidence values,

8   wherein said detection array has a detection array size equal to

9   said visualizer size; and

10   computing a coincidence detection value for each of said

11   visualizer elements such that said detection value represents a

12   visualizer.

13   44. A method for detecting a watermark in a marked image having a

14   plurality of image pixels, said marked image marked by a

15   watermarking plane having a plurality of watermarking elements,

16   said method comprising:

17   providing a visualizer pattern having a plurality of visualizer

18   pixels and a visualizer size;

19   aligning said watermarking plane with said marked image such that

20   each said image pixel has a corresponding watermarking element;

21   generating a statistically related variable for each image

22   element in a plurality of groupings of image elements in

23   relationship with said corresponding watermarking element;

24   wherein each of said groupings has a grouping size equal to said

25   visualizer size;

1   averaging said variable for each element in a like position of

2   all of said groupings to obtain a composite detection success

3   value; and

4   displaying detection success values by a plurality of

5   visualizer-coincidence pixels having a size equal to said

6   visualizer size, each said visualizer-coincidence pixel having a

7   same color as said corresponding visualizer pixel when said

8   corresponding success value indicates detection success and

9   another color otherwise.

10   45. A computer program product comprising a computer usable

11   medium having computer readable program code means embodied

12   therein for causing a watermark to be imparted into an image, the

13   computer readable program code means in said computer program

14   product comprising computer readable program code means for

15   causing a computer to effect the steps of claim 1.

16   46. A computer program product comprising a computer usable

17   medium having computer readable program code means embodied

18   therein for causing a watermark to be imparted into an image, the

19   computer readable program code means in said computer program

20   product comprising computer readable program code means for

21   causing a computer to effect the steps of claim 5.

22   47. A computer program product comprising a computer usable

23   medium having computer readable program code means embodied

24   therein for causing a watermark to be imparted into an image, the

25   computer readable program code means in said computer program

26   product comprising computer readable program code means for

27   causing a computer to effect the steps of claim 11.

1   48. A computer program product comprising a computer usable
2   medium having computer readable program code means embodied
3   therein for causing generation of a watermarked image, the
4   computer readable program code means in said computer program
5   product comprising computer readable program code means for
6   causing a computer to effect the steps of claim 13.

7   49. A computer program product comprising a computer usable
8   medium having computer readable program code means embodied
9   therein for causing formation of a watermarking plane, the
10   computer readable program code means in said computer program
11   product comprising computer readable program code means for
12   causing a computer to effect the steps of claim 14.

13   50. An article of manufacture comprising a computer usable medium
14   having computer readable program code means embodied therein for
15   causing detection of a watermark in a marked image, the computer
16   readable program code means in said article of manufacture
17   comprising computer readable program code means for causing a
18   computer to effect the steps of claim 15.

19   51. An article of manufacture comprising a computer usable medium
20   having computer readable program code means embodied therein for
21   causing detection of a watermark in a marked image, the computer
22   readable program code means in said article of manufacture
23   comprising computer readable program code means for causing a
24   computer to effect the steps of claim 16.

25   52. An article of manufacture comprising a computer usable medium
26   having computer readable program code means embodied therein for

1   causing generation of a visual representation of a data array of
2   data elements, the computer readable program code means in said
3   article of manufacture comprising computer readable program code
4   means for causing a computer to effect the steps of claim 39.

5   53. An article of manufacture comprising a computer usable medium
6   having computer readable program code means embodied therein for
7   causing a watermark to be imparted onto a digitized image, the
8   computer readable program code means in said article of
9   manufacture comprising computer readable program code means for
10   causing a computer to effect the steps of claim 18.

11   54. An article of manufacture comprising a computer usable medium
12   having computer readable program code means embodied therein for
13   causing a watermark to be imparted onto a digitized image, the
14   computer readable program code means in said article of
15   manufacture comprising computer readable program code means for
16   causing a computer to effect the steps of claim 19.

17   55. An article of manufacture comprising a computer usable medium
18   having computer readable program code means embodied therein for
19   causing detection of a watermark imparted onto a digitized image,
20   the computer readable program code means in said article of
21   manufacture comprising computer readable program code means for
22   causing a computer to effect the steps of claim 20.

23   56. An article of manufacture comprising a computer usable medium
24   having computer readable program code means embodied therein for
25   causing detection of a watermark in a marked image, the computer
26   readable program code means in said article of manufacture

1   comprising computer readable program code means for causing a
2   computer to effect the steps of claim 30.

3   57. An article of manufacture comprising a computer usable medium
4   having computer readable program code means embodied therein for
5   causing generation of a visual representation of a data array of
6   data elements, the computer readable program code means in said
7   article of manufacture comprising computer readable program code
8   means for causing a computer to effect the steps of claim 39.

9   58. An article of manufacture comprising a computer usable medium
10   having computer readable program code means embodied therein for
11   causing demonstration of an existence of a watermark in a marked
12   image, the computer readable program code means in said article
13   of manufacture comprising computer readable program code means
14   for causing a computer to effect the steps of claim 43.

15   59. A computer program product comprising a computer usable
16   medium having computer readable program code means embodied
17   therein for causing detection of a watermark in a marked image,
18   the computer readable program code means in said computer program
19   product comprising computer readable program code means for
20   causing a computer to effect the steps of claim 44.

21   61. An apparatus to impart a watermark onto a digitized image,
22   said apparatus comprising mechanisms for implementing the method
23   of claim 1.

24   62. An apparatus for imparting a watermark onto a digitized
25   image comprising mechanisms for implementing the method of claim
26   5.

1   63. An apparatus for imparting a watermark onto a digitized

2   image comprising mechanisms for implementing the method of claim

3   6.

4   64. An apparatus for imparting a watermark onto a digitized

5   image comprising mechanisms for implementing the method of claim

6   11.

7   65. A method for detecting a watermark in a marked image, said

8   method comprising:

9   providing said marked image having said watermark;

10   altering said marked image employing a blurring filter in

11   producing a filtered image; and

12   employing a watermark detection method upon said filtered image

13   to detect said watermark.

14   66. A method for detecting a watermark in a marked image, said

15   method comprising:

16   providing said marked image having said watermark;

17   processing the marked image and producing a screened image;

18   altering said screened image employing a blurring filter in

19   producing a filtered image; and

1   employing a watermark detection method upon said filtered image

2   to detect said watermark.

3   67. A method as recited in claim 66, wherein the step of

4   processing includes producing a derivative image by screening,

5   printing and scanning the marked image.

6   68. A method as recited in claim 15, wherein the step of aligning

7   includes altering said marked image employing a blurring filter.

8   69. A method as recited in claim 16, wherein the step of aligning

9   includes altering said marked image employing a blurring filter.

10   70. A method as recited in claim 20, wherein the step of aligning

11   includes altering said marked image employing a blurring filter.

12   71. A method as recited in claim 30, wherein the step of

13   providing includes altering said marked image employing a

14   blurring filter.

15   72. A method as recited in claim 44, wherein the step of aligning

16   includes altering said marked image employing a blurring filter.

17   73. An article of manufacture as recited in claim 51, wherein the

18   step of aligning includes altering said marked image employing a

19   blurring filter.

20   74. An article of manufacture as recited in claim 59, wherein the

21   step of aligning includes altering said marked image employing a

22   blurring filter.

1   75. An apparatus as recited in claim 62, wherein the means of
2   providing includes means for altering said marked image employing
3   a blurring filter.

4   76. A method of generating a visual representation of a data
5   array of data elements having a data array size, said method
6   comprising:

7   providing a visualizer pattern of visualizer pixels represented
8   by a visualizer array of visualizer elements, said visualizer
9   array having a visualizer array size equal to said data array
10   size, wherein each of said visualizer elements has a first
11   logical value if a corresponding visualizer pixel is a first
12   color and a complementary logical value if said corresponding
13   visualizer pixel has a second color;

14   forming a data image of image pixels represented by an image
15   array having an image array size equal to said data array size,
16   wherein an image pixel has a corresponding data element and a
17   corresponding visualizer pixel;

18   setting said data pixel to a color of said corresponding
19   visualizer pixel if a value of said data element is above a
20   predetermined threshold and to another color if said value is
21   below said predetermined threshold; and
22
23   displaying said data image to form said visual representation.

24   77. A method as recited in claim 76, wherein said data array
25   represents data resulting from a watermark detection
26   implementation.

1 78. A method as recited in claim 76, wherein said first color is
2 black and said second color is white.

3 79. A method as recited in claim 76, wherein said threshold is
4 set at a fifty percent success rate.

5 80. An article of manufacture comprising a computer usable medium
6 having computer readable program code means embodied therein for
7 causing generation of a visual representation of a data array of
8 data elements, the computer readable program code means in said
9 article of manufacture comprising computer readable program code
10 means for causing a computer to effect the steps of claim 76.

11 81. A computer program product comprising a computer usable
12 medium having computer readable program code means embodied
13 therein for causing generation of a visual representation of a
14 data array of data elements, the computer readable program code
15 means in said computer program product comprising computer
16 readable program code means for causing a computer to effect the
17 steps of claim 76.

18 82. An apparatus for generating a watermarked image comprising
19 mechanisms for implementing the method of claim 13.

20 83. An apparatus comprising mechanisms for implementing the
21 method of claim 14.

22 84. An apparatus for detecting a watermark in a marked image
23 comprising mechanisms for implementing the method of claim 15.

1　85. An apparatus for detecting a watermarking plane comprising
2　mechanisms for implementing the method of claim 16.

3　86. An apparatus for imparting a watermark onto a digitized image
4　comprising mechanisms for implementing the method of claim 19.

5　87. An apparatus for detecting a watermark comprising mechanisms
6　for implementing the method of claim 20.

7　88. An apparatus for detecting a watermark comprising mechanisms
8　for implementing the method of claim 30.

9　89. An apparatus for demonstrating an existence of a watermark in
10　a marked image comprising mechanisms for implementing the method
11　of claim 43.

12　90. An apparatus for detecting a watermark comprising mechanisms
13　for implementing the method of claim 44

14　91. A method for detecting a watermarking plane comprising the
15　steps of:

16　　　providing an image having a plurality of image pixels,
17　u(i,j), with said image having I rows and J columns, and a pixel
18　in row i and column j having at least one component, marked by a
19　watermarking plane; said watermarking plane having a plurality of
20　watermarking elements, w(i,j), with said watermarking plane
21　having I rows and J columns, and an element in row i and column j
22　having a brightness multiplying factor;

1   aligning said watermarking plane with said image;

2   identifying a subset of said image elements; and

3   for each pixel, $u(i,j)$, of said subset of image pixels,
4   employing a detection scheme in determining a probability of
5   watermark detection based on a property of uniform
6   distribution of the random brightness multiplying factors or
7   the random brightness adding or subtracting factors.